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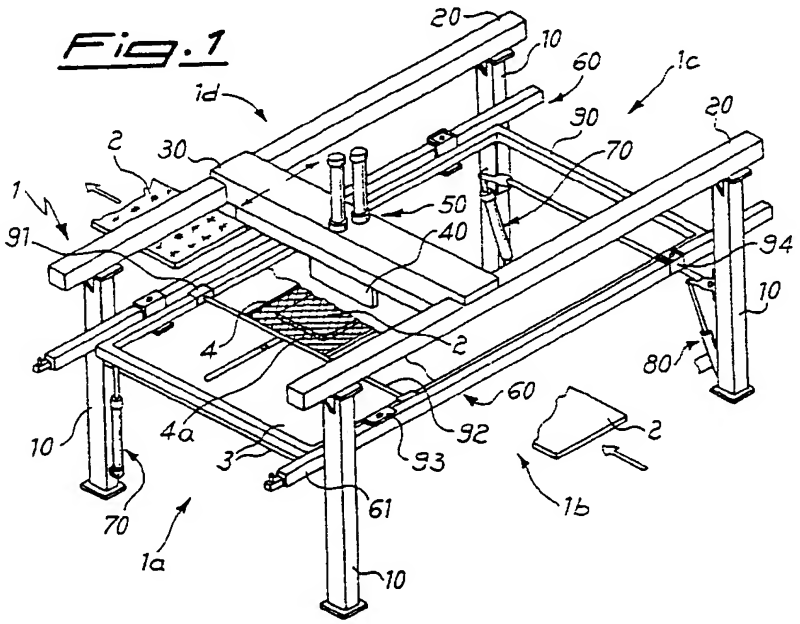
(54) Apparatus for gripping and registering a workpiece in a screen printing machine

(57) Machine for the silk-screen printing of flat articles such as sheets of glass (2) and the like, comprising at least four fixed uprights (10) supporting horizontal parallel beams (20) on which a bridge (30) carrying the printing means (40) is movable, and a surface (3) for resting the glass (2), said machine comprising an apparatus (100; 1000) for gripping and centring the glass (2) with respect to the fixed printing screen (4).

Fig.1



Description

The present invention relates to a machine for the silk-screen printing of substantially flat sheets such as sheets of glass, panels and the like, equipped with apparatus for the automatic adjustment of the relative position of the sheet being processed with respect to the fixed printing screen.

It is known, in particular in the glass sector, of the need to print decorations and the like onto flat sheets such as sheets of glass and the like, by means of the silk-screen printing technique, as are also known silk-screen printing machines especially designed for this purpose and provided with devices for adjusting the position of the printing frame relative to the surface of the glass, both in directions lying in a plane parallel to the glass itself and in a vertical direction perpendicular to the plane of the glass; in this vertical direction the so-called "off contact" distance of the printing screen from the glass itself is determined, said distance serving to avoid printing smudges which would occur if the screen were in contact with the glass.

An example of such machines is described in the patent application IT-94A 2203.

Said machines of the known type, however, have some drawbacks including the need of having to perform relative centring of the sheet on which silk-screen printing is to be performed and the printing frame, by means of manual adjustments of the position of the frame itself with respect to the sheet which, on the other hand, is kept locked in a suitably predefined position.

This type of relative centring of printing frame and sheet on which silk-screen printing is to be carried out requires, however, that the entire printing frame be displaced in order to be able to perform the said adjustments, thus causing considerable difficulties during execution and measurement errors, mainly due to the inevitable play which forms between the various parts making up the said frame.

The technical problem which is posed, therefore, is that of providing a machine for the silk-screen printing of flat articles such as sheets of glass and the like, which allows rapid and precise relative centring of the sheet to be printed also in the case of glass sheets with an asymmetrical profile.

Within the scope of this technical problem, a further object is that of providing a machine which comprises relative centring means allowing the said operation to be performed both in a totally automatic manner and in a semi-automatic manner.

These results are obtained by the present invention, which comprises a machine for the silk-screen printing of flat articles such as sheets of glass and the like, equipped with an apparatus for the automatic adjustment of the relative position of the sheet being processed with respect to the fixed printing screen.

Further details may be obtained from the following description, with reference to the accompanying drawings, in which:

Figure 1	shows a schematic axonometric view of a machine according to the invention;
Figure 2	shows a front view from the front side of the machine according to Fig. 1;
Figure 3	shows a schematic view of the machine along the plane indicated by III-III in Fig. 2;
Figure 4	shows a schematic section along the plane indicated by IV-IV in Fig. 3 of the device for locking and centring the glass with respect to the frame in the manual adjustment version;
Figure 5	shows a plan view of the movable guides of the centring device according to Fig. 4;
Figure 6	shows a section along the plane indicated by IV-IV in Fig. 3 of the device for locking and centring the glass with respect to the frame in the automatic adjustment version;
Figure 7	shows an enlarged view of the end parts of the section according to Fig. 6;
Figures 8a, 8b	show a schematic vertical section of the torque-limiting coupling for locking the glass respectively in the positions with the rollers open and the rollers closed;
Figures 9a, 9b	show a schematic view of the means for automatic centring of the glass with respect to the frame.

As shown in Figure 1, the machine 1 according to the invention is composed of four uprights 10 supporting two fixed beams 20 fastened to the top ends of the said uprights 10. Said beams have mounted on them slidably in the longitudinal direction a bridge 30 which has fixed to it the support carrying the doctor blade 40, the squeegee and associated means 50 for operation thereof in a direction perpendicular to the plane of the glass 2. The orientation of the machine is such that there is a front side 1a where the operator stands, a side 1b for the supplying of the glass sheets 2, a rear side 1c, and a side 1d for unloading the glass.

The uprights 10 also have connected to them two longitudinal guides 60 which can be operated so as to move in a substantially vertical direction with respect to

the underlying surface 3 supporting the glass 2 by means of associated actuating devices 70 and 80.

Said guides 60 have fixed to them the counter-frame 90 which carries the frame 4 of the printing screen 4a.

The frame 4 supporting the screen 4a is fixed to the counter-frame 90 by means of cross-pieces 92 sliding by means of supports 91 on the counter-frame itself, which is in turn fastened to the guides 60 by means of holes in the counter-frame 90 inside which corresponding pins of means 160 for adjusting the position of the counter-frame, fixed to the cross-pieces 60 (Fig. 3), are accommodated.

Said adjusting means 160 act so as to position the counter-frame 90, and hence the frame 4, in the different directions of the horizontal plane and with respect to the predetermined zero position of the machine.

The bridge 30 (Fig. 1) carries the group 50 for moving the support 40 carrying the doctor blade and the squeegee. Said moving group substantially consists of a pair of cylinders arranged behind on another in the longitudinal direction of the machine and respectively connected to the printing doctor blade and to the spreading squeegee.

Operation of the machine is as follows: once the printing screen 4 has been prepared, the said screen is mounted on the counter-frame 90 by sliding the cross-pieces 92 by the required amount and locking them in position; then the counter-frame 90 is mounted on the guides 60 on which it rests by means of rectangular blocks 93.

At this point, by operating the handwheels 160, adjustment of the counter-frame 90 with respect to the horizontal surface 3 supporting the glass 2 is performed, obtaining definitive positioning of the counter-frame and hence the screen 4a.

The lugs 93 are finally fixed, via known means, to the guides 60, thus making the counter-frame 90 perfectly integral with the said guides.

In Fig. 3 it can be seen how the working surface 3 has formed in it at least three slits 3a arranged in the two directions - longitudinal and horizontal - of the machine; more particularly, the example in the Figure shows two slits parallel to the transverse direction and one slit parallel to the longitudinal direction; it is obvious, however, that it is possible to provide any combination of the positions of the said slits in relation to the specific requirements.

As can be seen in Figs. 4 and 5, each slit 3a in the surface 3 has associated with it a device 100 for centring the glass 2 with respect to the printing screen 4a; said device comprises at least one support 101 fixed in the vertical direction to the surface 3 on which the glass 2 rests, by means of associated means arranged in the vicinity of the opposite ends of the guide itself and comprising a sliding shoe 101a, substantially in the form of an upturned U, suitable for allowing relative sliding, in the longitudinal direction, of the support 101 with respect to the fixed surface 3, as will be explained more clearly below.

The upper surface of the support 101 has formed in it two longitudinal guides 101b arranged symmetrically with respect to the line of transverse symmetry of the support 101.

Each longitudinal guide 101b has housed inside it a sliding carriage unit 102 on which there is fixed a vertical flange 102a, the upper free end of which has mounted on it a roller 102b idle on a vertical axis; more particularly said roller is supported by a horizontal support 102c extending towards the outside so as to allow a greater travel in relation to the dimensions of the glass 2, as will be explained more clearly below.

Each carriage unit 102 is also attached on opposite sides to a toothed belt 103 forming an endless loop on two idle pulleys 103a arranged at the opposite ends of the support 101.

One of the two carriage units 102 is moreover fastened to the free end of the rod 104a of a pneumatic cylinder 104, the travel of which causes movement of the toothed belt 103 in both directions and therefore the symmetrical movement towards one another or away from one another of the two carriage units 102 and hence the rollers 102b projecting on the working surface. More particularly the outward movement of the rod 104a causes movement of the carriage units 102 away from each other towards the end of the guide 101, while the inward movement of the rod causes a relative approaching movement of the carriage units towards the centre of the guide 101.

Said cylinder, if suitably calibrated, determines moreover the closing force on the glass and retention thereof during the various operations.

As shown in Fig. 4, the fixed working surface 3 also has secured to it a flange 105, substantially in the form of an upturned L, on the vertical side 105a of which are mounted the means 200 for adjusting the relative longitudinal position of the support 101 and the fixed working surface 3.

Said adjusting means 200 substantially consist of a horizontal screw 201 passing through a hole 105b in the side 105a of the L-shaped flange 105, the threading 201a of the screw 201 being designed to engage with a female thread 302a of a projection 302 fixed to the support 101. The head of the screw comprises an operating handwheel 201b which acts on a stop piece comprising a digital counter 201c which displays the measurement of the displacement performed by the screw 201.

With this configuration, the rotation of the handwheel in either direction causes sliding, in the longitudinal direction, of the support 101 on the sliding shoe 101a in the form of an upturned U integral with the fixed surface 3.

Operation of the machine in the configuration for manual adjustment described above is as follows:

Once the silk-screen printing machine has been prepared and the printing screen 4 positioned in its seat

(Figs. 1 and 3) on the counter-frame 90 and the latter positioned on the guides 60 in a fixed position on a plane parallel to the glass 2 and then locked to the guides 60 themselves via known means associated with the lugs 93, the sheet of glass 2 is supplied (by means of associated devices not shown), arranging it on the working surface 3 in an approximately centred position.

At this point, sensors, not illustrated, cause activation of the devices 100 for centring the glass 2 with respect to the printing screen 4a: more particularly (Fig. 4) the cylinders 104 associated with each support 101 are actuated so as to cause retraction of the rod 104a inwards; the travel of the rod 104a causes movement, in an anti-clockwise direction, of the toothed belt 103, the rotation of which about the pulleys 103a causes the symmetrical movement towards one another of the carriage units 102 which, by means of the horizontal support 102c, transport the rollers 102b towards the sheet 2 arranged on the working surface 3, until they come into contact with the edges of the said sheet, resulting in stable holding thereof.

The symmetrical closure of the rollers 102b against the sides of the sheet 2 causes stable gripping thereof by the rollers and displacement of the sheet towards the centre position of the machine; during this stage the glass 2 is therefore kept integral with the devices 100 and centred with respect to the machine, but not with respect to the screen 4a; it is therefore necessary to centre the glass 2 with respect to some printing reference points 4b present on the screen 4a itself (Fig. 9a).

In order to obtain this centring action, the operating handwheels 201b of each support 101 are operated so that, by means of the screw 201, they cause the translation of the respective support 101, and hence the sheet 2 integral therewith, by means of the rollers 102b: in this way it is possible to centre the glass 2 with respect to reference points of the printing screen 4a, moving with micrometric precision the glass with respect to the printing frame rather than vice versa.

The handwheels 201b operating the screws 201 may also have associated with them an instrument for digital measurement 201c suitable for displaying the relative displacement of the support 101 and allowing recording of said measurements so as to be able to print identical batches of glass sheets also in different time periods, reducing to a minimum the idle time for preparation of the machine.

With reference to Figs 6 to 9b, a second, totally automated embodiment 1000 of the device for centring the glass 2 is now described.

As illustrated in Figs. 6 and 7, the apparatus 1000 for centring, with automatic adjustment, the glass 2 with respect to the printing screen 4a retains the same basic components of the version for manual adjustment, namely: the support 101, the carriage units 102 carrying the rollers 102b gripping the glass 2, the screws 201 for translation of the supports 101, with which there are associated devices 500 for automatic control and operation of the toothed belt 103, devices 600 for operation and control of the screw 201, devices 700 (Fig. 9b) for detecting the relative position of the screen 4a and for controlling and operating the actuating devices 600.

More particularly, one of the two pulleys 103a supporting the toothed belt 103 is driven by means of a gearmotor 501 operating a drive shaft 502 coaxial with the pulley 103a which is coaxially constrained, by means of a tongue 520a, with a driven shaft 520. The gearmotor is fixed to the support 101 by means of associated connecting elements 502b.

Between the said drive shafts 502 and the driven shaft 520 there is arranged a torque-limiting coupling 510 comprising a base 511 which is fixed to the shaft 502 of the gearmotor and retained by a clamp 511a and by a washer 511b which are connected together.

Coaxially with the base 511 there is arranged a safety spacer 512 which has keyed inside it a bush 513, the upper edge of which has a circular lip 513a to which a first end of a torsion spring 514 is fixed, the other end being fixed to the washer 511b.

Transversely with respect to the shaft 520 and in a position contained in the axial dimension of the bush 513 there is formed a seat 512b in which a first pin 515a is accommodated.

On the shaft 502 and below the said first pin 515a there is also arranged a second pin 515b perpendicular to the first pin and inserted in an inclined recess 516 forming a cam formed on the bush 513.

Opposite the external surface of the said circular lip 513a of the bush 513 there is also arranged a proximity sensor 517 fixed to the support 101 by means of an adjustable flange 517a.

The screw 201 operating the support 101 is in this case actuated by a servomotor 602 provided with a measuring device 601 and connected to data processing devices in turn connected to the devices 700 for detecting the position of the printing screen 4a described below.

Said devices 700 (Fig. 9b) for detecting and controlling relative centring of glass 2 and printing screen 4a comprise two telecameras 701 inserted in corresponding holes 701a of the surface 3 and the lens of which, if necessary illuminated by a corresponding light source 702 arranged above the printing frame 4, is able to detect the image of a reference point 4b suitably positioned on the printing screen 4a, transforming the optical signal into a corresponding digital electrical signal, to be sent to an electronic device 703 for processing the data in turn able to send command signals to the motors 602 for actuating the respective screws 201.

Operation of the automatic centring device is as follows:

Once the silk-screen printing machine has been prepared and the printing frame 4 positioned in its seat, the telecameras 701 detect any misalignment of the reference points 4b of the screen 4a with respect to the ideal vertical axis of alignment between telecamera and

reference point 4b and, on the basis of the optical signal representing said misalignment, send corresponding electrical signals to the unit 703 controlling the actuating operations so that the said unit is able to calculate the correction to be made to the final position of the sheet, so that the latter is displaced with respect to the fixed reference points of the machine (telecameras) by the same amount with which the frame 4 is displaced, thus resulting in positioning of the sheet 2 centred with respect to the screen 4a whatever the displacement of the latter with respect to the fixed reference points and whatever the shape and the entry position of the sheet onto the working surface 3.

Therefore when the sheet enters onto the working surface, sensors cause activation of the devices for centring the glass 2 with respect to the printing screen 4a: more particularly, the gearmotor 501 is activated, such that it causes rotation of the drive shaft 502, said rotation (Figs. 3a, 8b, 7) causing movement, by means of the second pin 515b and the spring 514, of the bush 513 which causes rotation of the driven shaft 520 which in turn rotates the pulley 103a which moves the toothed belt to which the carriage units 102 are attached, the latter moving symmetrically towards one another until the rollers 102b come into contact with the respective edges of the sheet 2 against which they start to press.

This pressure causes stoppage of the toothed belt 103 and hence the motor-driven pulley 103a and the driven shaft 520, while the drive shaft 502 continues to rotate; said rotation causing sliding of the pin 515b on the inclined cam 516 of the bush 513, causing axial raising of the bush itself and hence translation of its lip above the proximity sensor 517 which sends a stop signal to the gearmotor 501.

From this point on, the rollers are kept in the closed condition by the spring 514, calibration of which may be predefined by means of adjustment of the base 511.

Below closing of the rollers 102b, the telecameras 701 detect the position of the reference marks 4b arranged on the screen 4a with respect to the fixed reference points (telecameras), calculating the misalignment thereof with respect to the telecameras themselves which send suitable signals to the control unit 703; the latter activates the motor 602 for operation of the respective screw 201 which causes displacement of the support 101 so that stoppage of the rollers 102 gripping the glass is performed in relative positions such as to cause centring of the glass 2 with the printing screen 4a.

It must also be emphasized how the centring apparatus according to the invention also allows detection and compensation, during printing, of any displacements from the initial position of the reference points 4b of the screen 4a due to the elastic deformation of the latter, thus minimising the idle time and production rejects due to this cause.

Claims

1. Machine for the silk-screen printing of flat articles such as sheets of glass (2) and the like, comprising at least four fixed uprights (10) supporting horizontal parallel beams (20), on which a bridge (30) carrying printing means (40) is movable, and a surface (3) for resting the glass (2), characterized in that it is provided with an apparatus (100; 1000) for gripping and centring the glass (2) with respect to the fixed printing screen (4a).

2. Machine according to Claim 1, characterized in that said centring apparatus (100; 1000) comprises at least one support (101) which is movable on respective sliding shoes (101a) integral with the fixed printing surface (3) and which carries a pair of gripping elements (102b), symmetrically movable in translation with respect to one another under the operating action of associated actuating means (104; 500) and transmission means (103, 103a), for engagement with the sheet (2) to be centred, said movable support (101) having associated with it corresponding means (201, 201a) for effecting translation connected to associated operating means (201b; 602).

3. Machine according to Claim 1, characterized in that said means for effecting translation of the support (101) consist of a screw (201) suitable for engagement with a corresponding female thread (302a) integral with the support (101).

4. Machine according to Claim 1, characterized in that said supports (101) are at least three in number.

5. Machine according to Claim 1, characterized in that said transmission means associated with each support (101) comprise a pair of carriage units (102) carrying said gripping means (102b) and attached to a toothed belt (103) forming an endless loop on two pulleys (103a) which are pivotably mounted at the opposite ends of each movable support (101).

6. Machine according to Claim 1, characterized in that said means for actuating the toothed belt (103) consist of a pneumatic cylinder (104).

7. Machine according to Claim 1, characterized in that said means (500) for actuation of the toothed belt (103) consist of a gearmotor (501) operating a drive shaft (502) connected, via a torque-limiting coupling (510), to a driven shaft (520) carrying one of the pulleys (103a).

8. Machine according to Claims 1 to 7, characterized in that said torque-limiting coupling comprises a bush (513) which is coaxial with the shaft (502) and

has an end lip suitable for co-operating with sensor means (517) and inside which a cam (516) is formed.

9. Machine according to Claims 1 to 8, characterized in that said cam (516) is formed by an inclined groove formed on the internal surface of the bush and suitable for co-operating with a corresponding pin (515b) transversely accommodated in the shaft (502).

10. Machine according to Claim 1, characterized in that said centring apparatus (100) is of the manual adjustment type.

11. Machine according to Claims 1 and 10, characterized in that said means for operating the screw (201) for translation of the support (101) consist of a manual handwheel (201b).

12. Machine according to Claims 1 and 10, characterized in that said means for operating the screw (201) are associated with means for digital display of the position assumed..

13. Machine according to Claim 1, characterized in that said centring apparatus (1000) is of the automatic adjustment type.

14. Machine according to Claims 1 and 13, characterized in that said means for operating the screw (201) consist of a servomotor (602) controlled by means of a CNC device connected to means for detecting the position of the reference points (4b) formed on the printing screen (4a).

15. Machine according to Claims 1 and 13, characterized in that said means for detecting said reference points (4b) consist of a pair of telecameras (701) fixed to the working surface (3) and illuminated by corresponding light sources (702) arranged above the screen (4a).

Fig.1

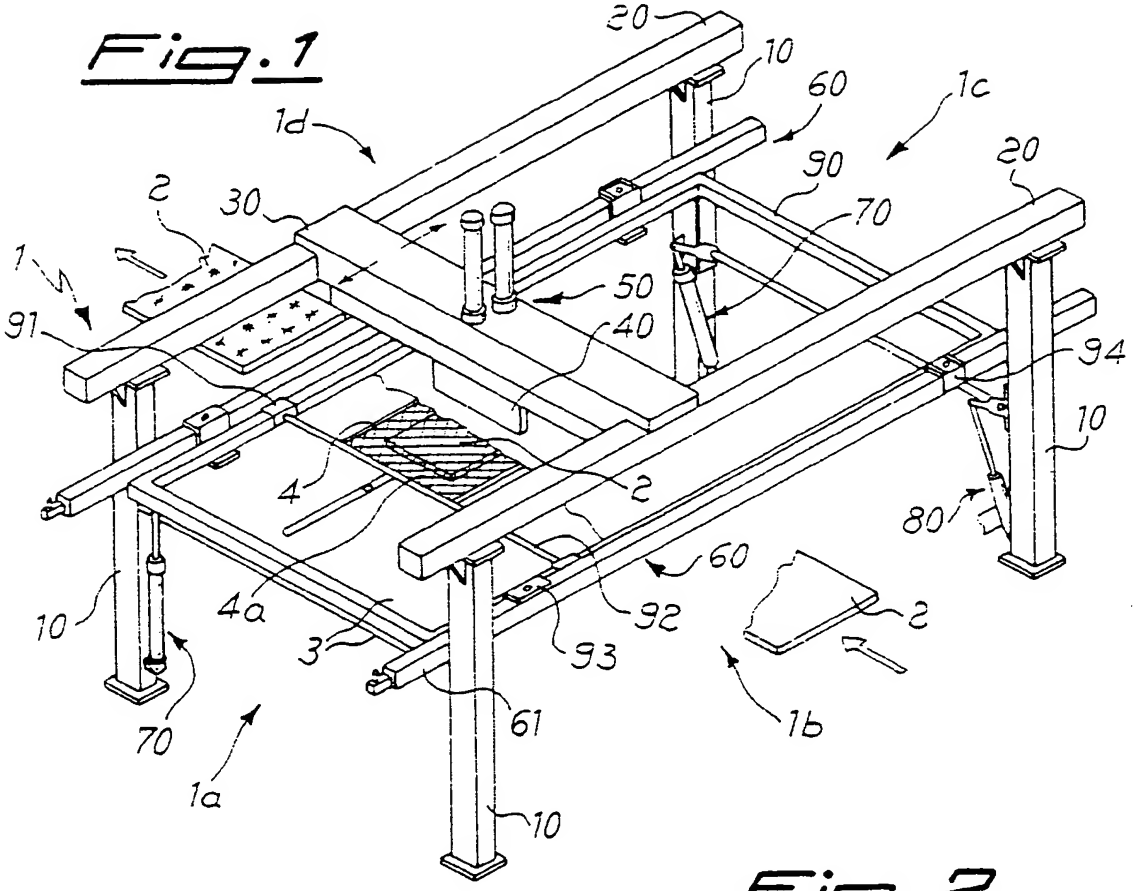


Fig.2

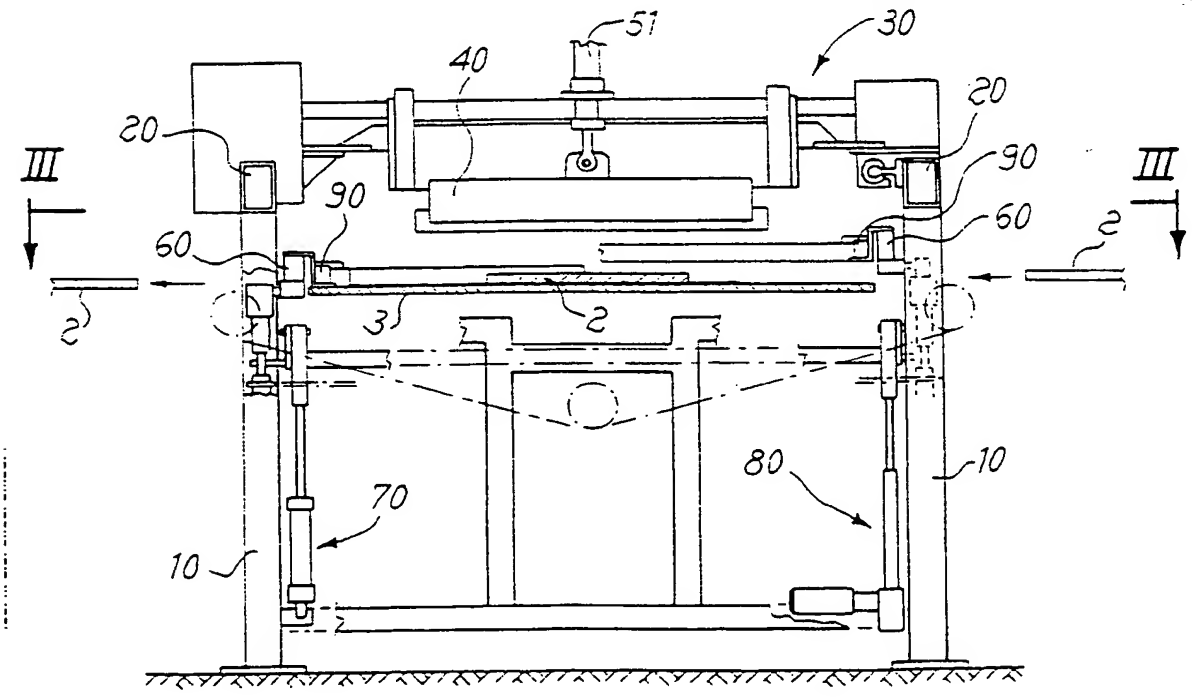


Fig. 3

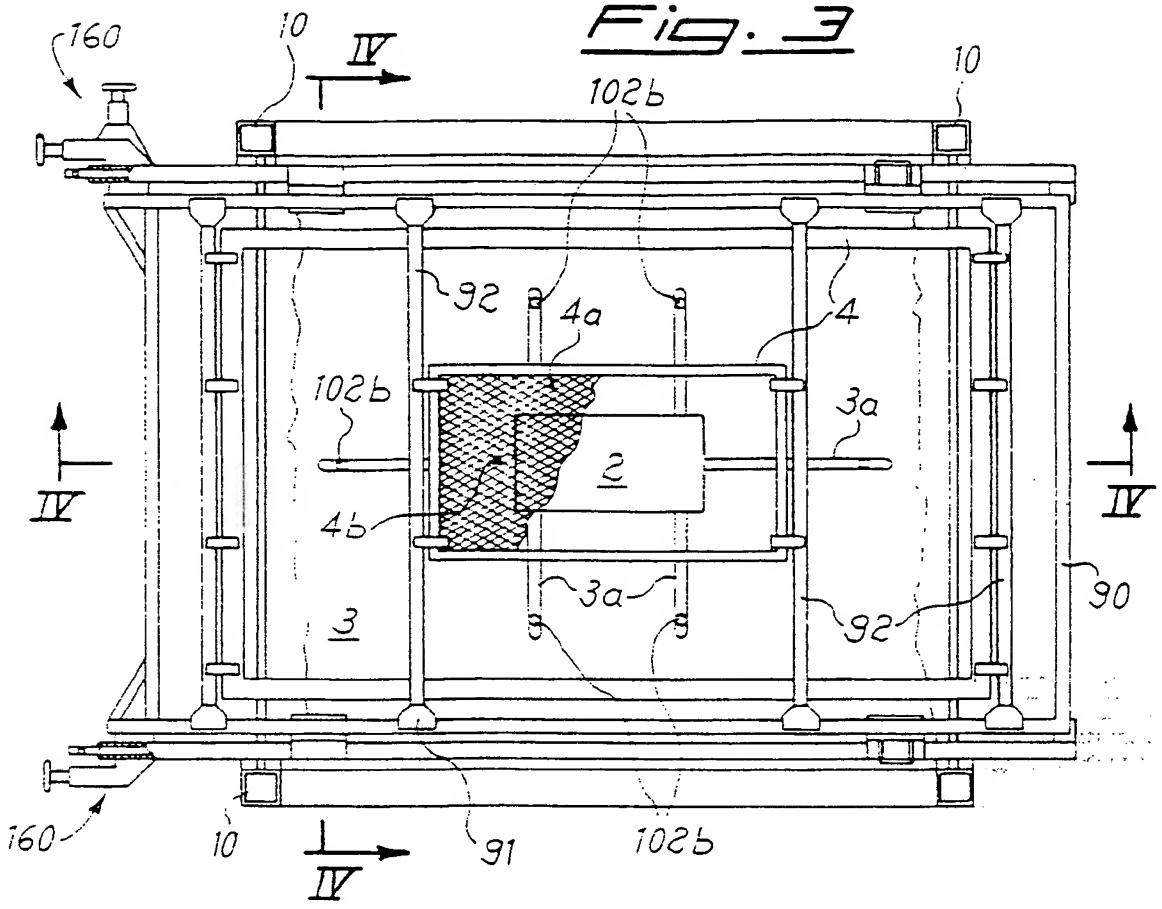


Fig. 8

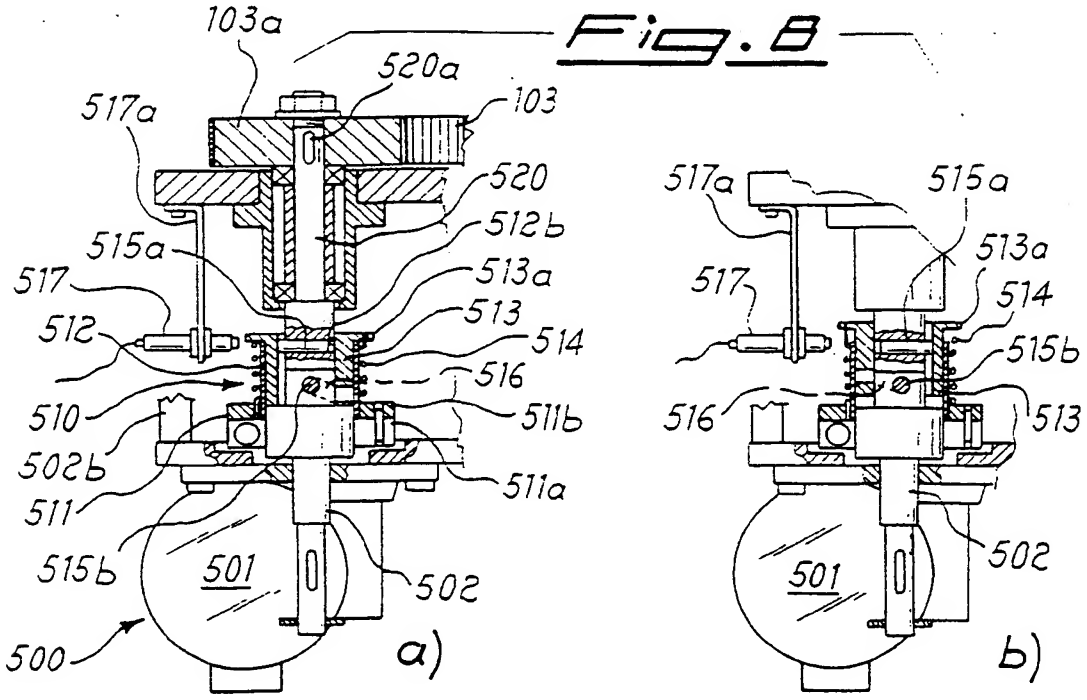


Fig.4

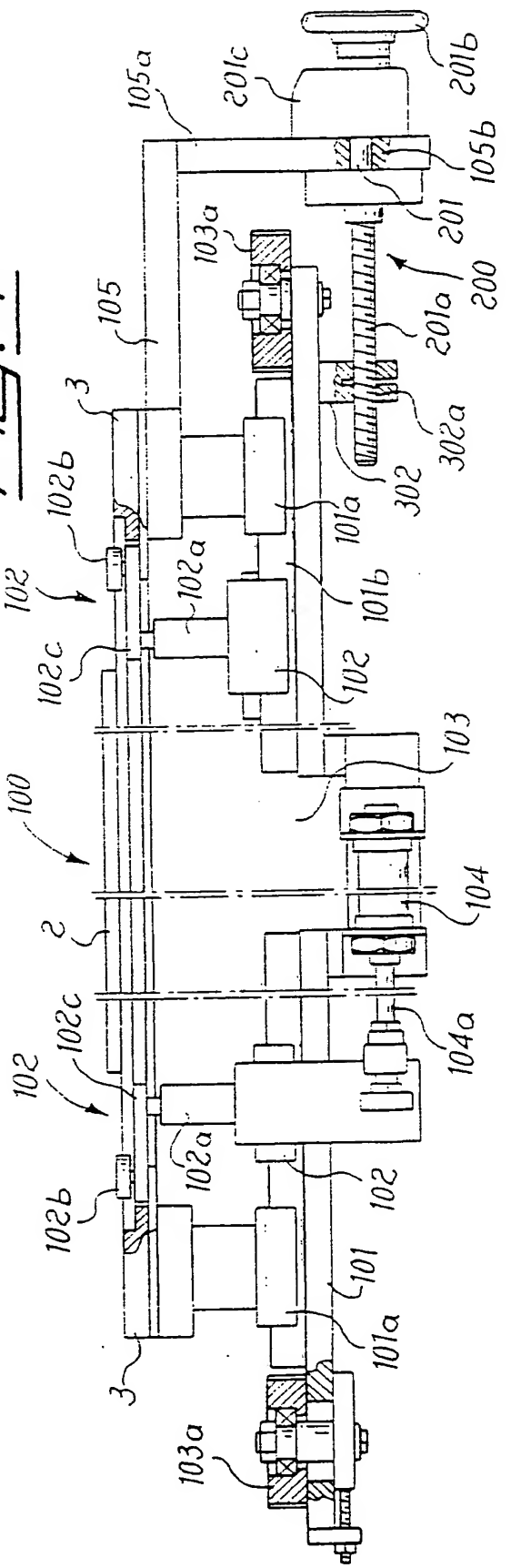


Fig.5

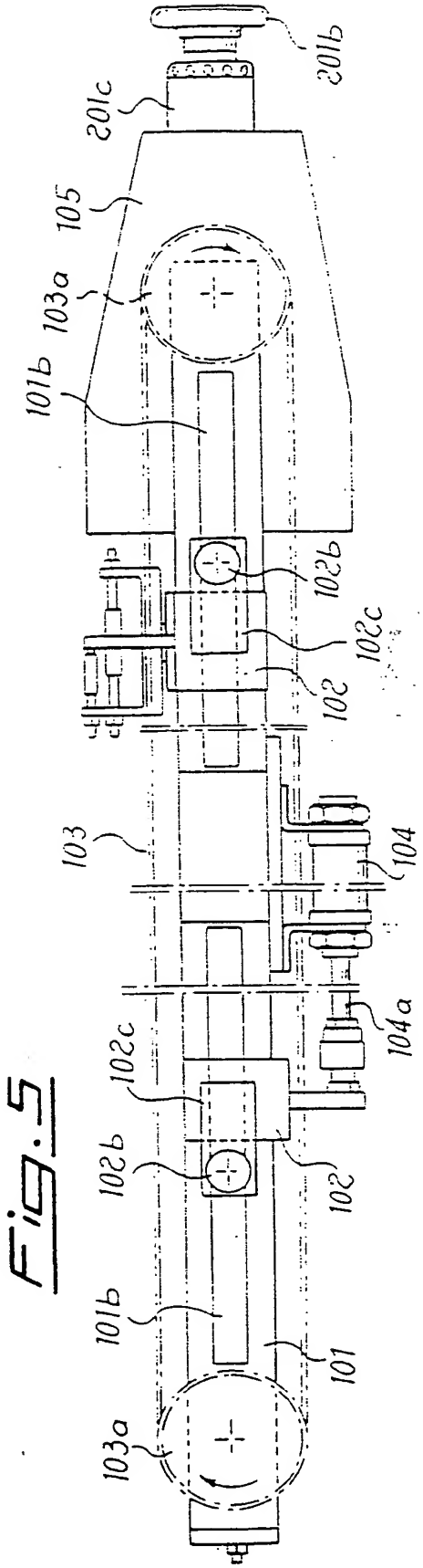


Fig.6

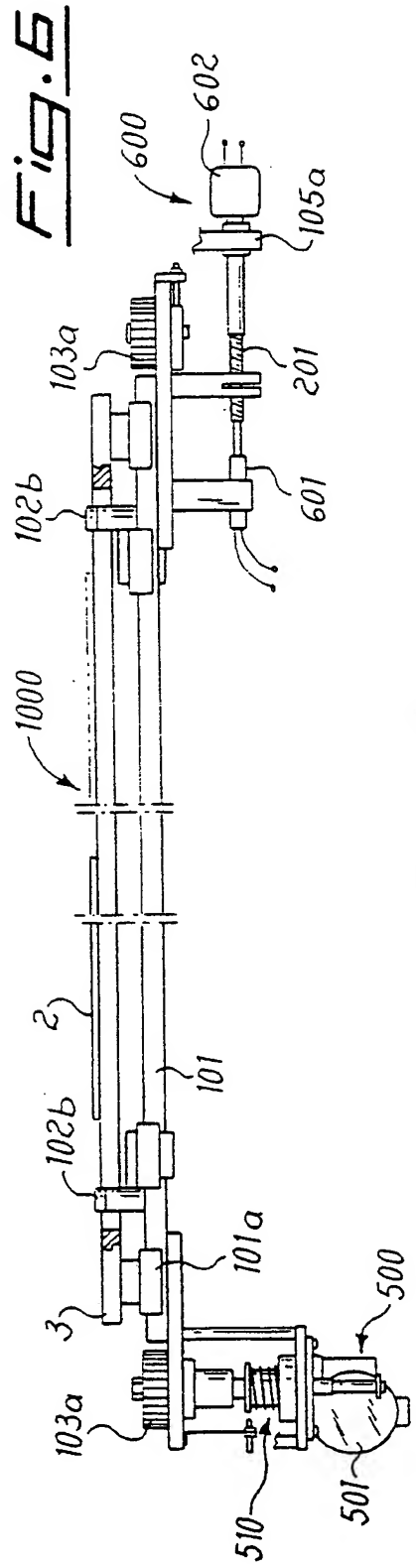


Fig.7

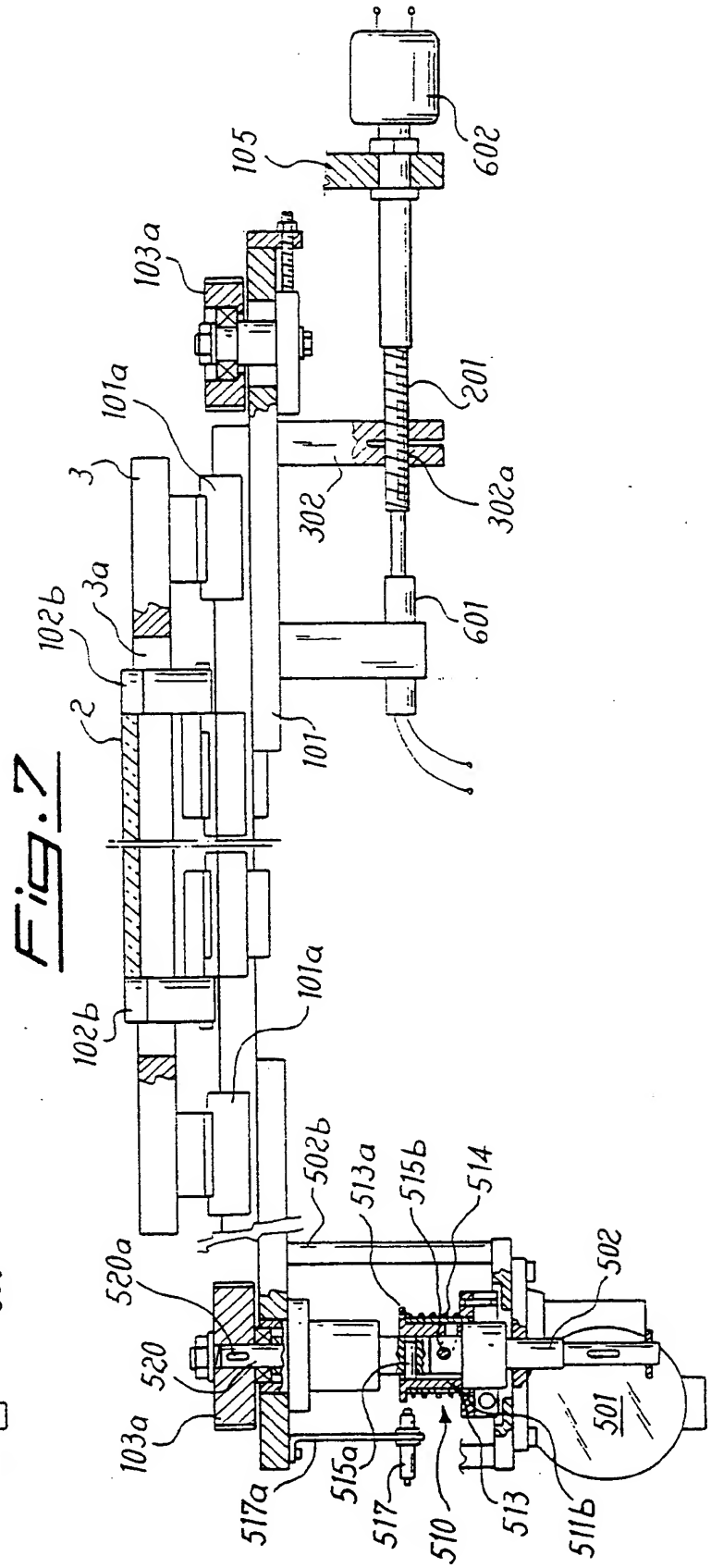


Fig. 9a

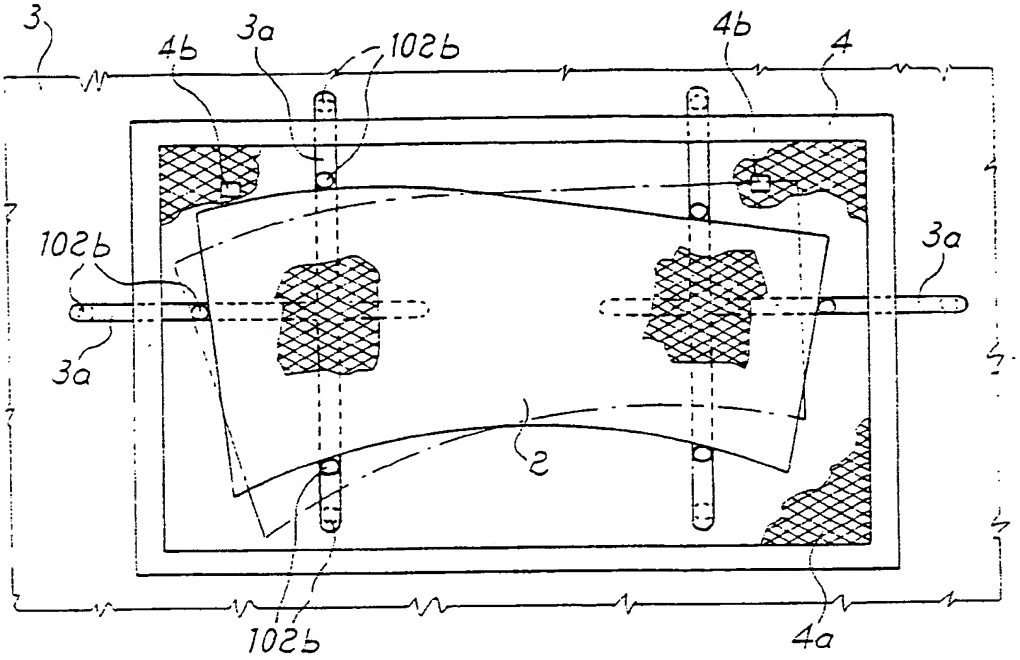
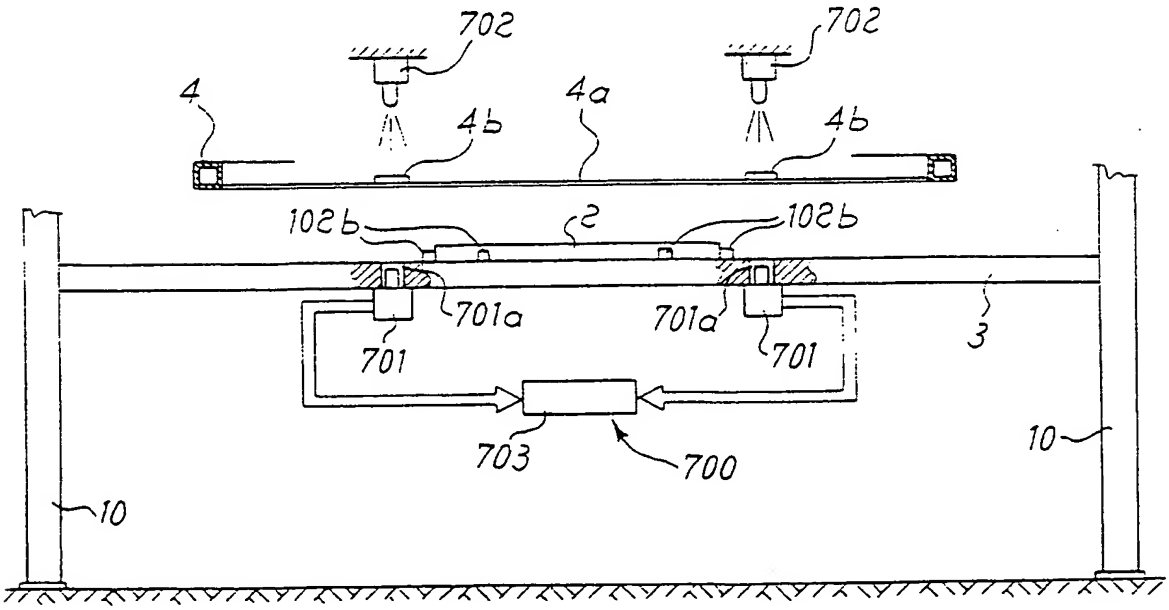


Fig. 9b



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EUROPEAN SEARCH REPORT

Application Number
EP 97 20 2236

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 389 936 A (JAFFA ET AL.) * figures 1-3 * * column 4, line 31 - column 5, line 32 * ---	1	B41F15/26
A	US 4 246 866 A (HOPINGS ET AL.) * abstract; figures * * column 5, line 34 - column 6, line 5 * -----	1,2	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 October 1997	Helpiö, T.

CATEGORY OF CITED DOCUMENTS

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